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SITE (Superfund Innovative Technology Evaluation) Program: The Results to Date

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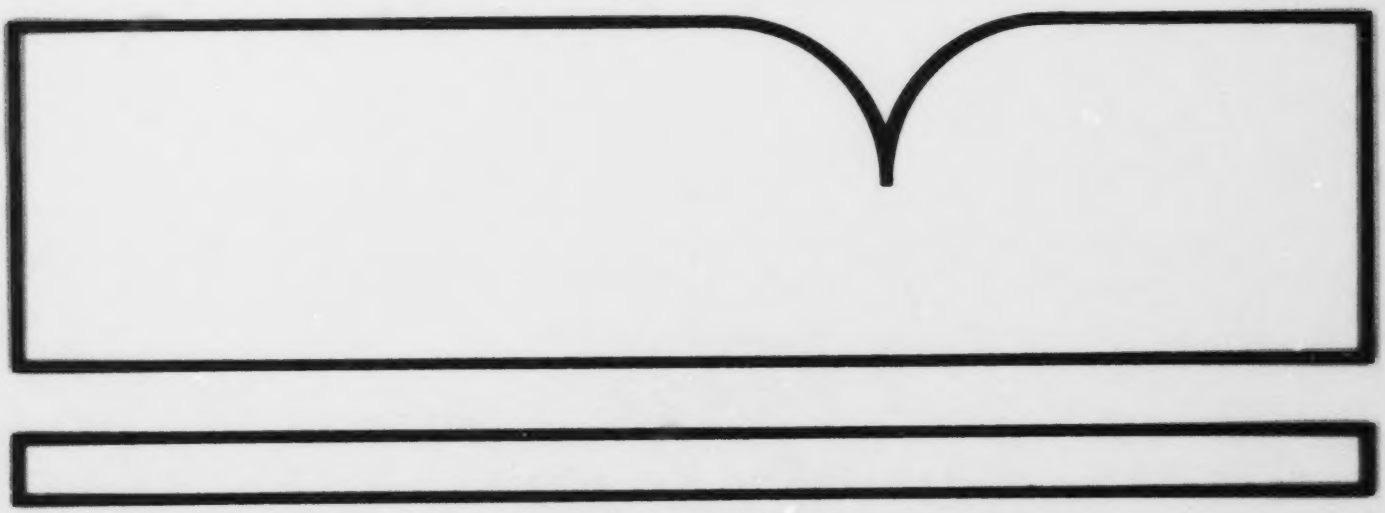

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SITE Program: The Results to Date

by

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The Environmental Protection Agency's Office of Research and Development (ORD), joining with the Office of Solid Waste and Emergency Response (OSWER), has initiated the SITE program. The SITE program will help EPA find, test, and encourage the use of new ways to destroy, stabilize, or otherwise treat hazardous wastes, rather than just bury them in the ground. The overall goal of the SITE program is to maximize the use of alternatives to land disposal and containment at Superfund sites. To accomplish this goal, the program will provide reliable cost and performance information on technologies that offer an alternative to land disposal. This information will be generated by conducting pilot-scale or full-scale demonstrations of alternative technologies at Superfund sites.

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SITE Program: The Results to Date

Ronald D. Hill*

Introduction

The U.S. Environmental Protection Agency's (EPA) Office of Research and Development (ORD), joining with the Office of Solid Waste and Emergency Response (OSWER), has initiated the Superfund Innovative Technology Evaluation (SITE) program. The SITE program will help EPA find, test, and encourage the use of new ways to destroy, stabilize, or otherwise treat hazardous wastes, rather than just burying them in the ground.

The overall goal of the SITE program is to maximize the use of alternatives to land disposal and containment at Superfund sites. To accomplish this goal, the program will provide reliable cost and performance information on technologies that offer an alternative to land disposal. This information will be generated by conducting pilot-scale or full-scale demonstrations of alternative technologies at Superfund sites.

Background

EPA's Superfund program is designed to clean up hazardous waste sites around the country. It has been under way for 6 years with action taken at over 450 Superfund sites to address long-term problems created by hazardous wastes. More than half of these sites have involved burying the hazardous wastes in specially prepared landfills--a process called land disposal. While land disposal can be a good way to handle wastes, in some instances it does not provide a permanent solution to the problem. The wastes in the landfill may still be dangerous and may potentially leak through the confines of the burial site.

Recently, members of the scientific community, the public, and Congress expressed concern that it was time to move away from reliance on land disposal for handling hazardous wastes. These views are reflected in the Hazardous and Solid Waste Amendments of 1985 (HSWA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). The Agency responded by altering certain policies and developing regulations regarding hazardous waste disposal in landfills and the expanded use of alternative technologies.

More specifically, the Land Disposal Restriction provisions of HSWA stipulate that certain wastes cannot be land disposed unless they meet specific concentration-based treatment standards that represent best

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demonstrated available technology. Similarly, the new SARA sets a clear preference for the use of cost-effective treatment remedies which permanently and significantly reduce the toxicity, mobility, or volume of wastes at Superfund sites. In addition to these provisions, SARA directs EPA to carry out a program of research, evaluation, testing, development, and demonstration of alternative or innovative technologies to achieve more permanent protection of human health and welfare and the environment. These laws, regulations, and policies clearly provide the impetus toward the use of treatment alternatives for the management of hazardous wastes. Technical and policy guidance on the use and availability of alternative technologies in both the Superfund removal and remedial programs is expected soon.

Site Program Phases

The four phases of the SITE program listed below are being conducted simultaneously. They will be integrated so that information from one phase can be used in another. Each phase is designed to meet a particular objective of the SITE program. The SITE program will be periodically reviewed to determine how information generated from all phases may be used to encourage the selection of new technologies at Superfund sites.

° Phase I: Identify and Remove Impediments

Trained engineers, economists, and policy analysts will identify the obstacles to the orderly development and use of alternative technologies to manage hazardous wastes. Resolving issues dealing with permit requirements, treatment residue disposal, liabilities, procurement requirements, and public interest will help pave the way to increased use of treatment alternatives. Recommendations on how EPA can remove or limit obstacles to the use of alternative technologies will be complete in 1987.

° Phase II: Conduct a Demonstration Program

EPA will conduct a demonstration program for innovative technologies at selected Superfund sites or at a facility processing hazardous waste. From these demonstrations, EPA will develop performance and cost information for the new technologies. This information will help EPA decide under what circumstances to use the technology at hazardous waste sites.

The demonstration program will be an ongoing effort. EPA plans to start several demonstrations as soon as possible to obtain information on the most advanced technologies. Demonstrations will then occur on a yearly schedule. An annual SITE demonstration plan will be published for public comment and will discuss the proposed technologies to be demonstrated and the Superfund sites identified for use that year. A report on the current status of the demonstration program is reported later.

° Phase III: Applications Analyses

Successful demonstration of a technology will not guarantee that a technology will in fact be adopted for full-scale use at Superfund sites. In addition to the analysis of impediments and the demonstration programs described earlier, the SITE program includes an analysis of the investment potential and long-term demand for a technology.

SITE, therefore, has included an analysis of the potential demand for a given technology in its program to assist developers in planning for commercialization of their technology. The analysis is not intended to replace the normal market analysis performed by the private sector, but rather will provide information to help improve the accuracy of such analysis as well as assist the EPA in long-term program planning. The effort primarily will be directed to determine how many sites can use a given technology. This may involve additional tests using surrogate wastes at a test and evaluation facility.

° Phase IV. Emerging Technologies Development

While much of the SITE program necessarily is focused on technologies that are ready for demonstrations to accelerate their acceptance into routine commercial use, it is recognized that there may be technologies in a lesser state of development which deserve attention. Therefore, the SITE program includes a development program to assist the development of technologies from the laboratory and pilot-scale phases to the demonstration phase. This work usually should be performed by the private sector. However, where attractive technologies have not generated sufficient private sector interest, the EPA may choose to assist their development.

The development program is similar to the demonstration program. The EPA will monitor nonfederal research and development activities to identify promising technologies. There will be routine solicitations to allow developers to propose a program of EPA assistance to develop their technologies. The EPA intends to focus on emerging alternative technologies that deal with recycling, separation, detoxification, destruction, and stabilization of hazardous constituents. The selection of technologies for EPA support will be based on the same criteria as the selection process under the demonstration program, plus consideration of the capability of the developer to conduct the work.

The program also may involve extensive use of EPA inhouse capabilities. The Agency has several test and evaluation facilities which may be appropriate to further research and develop specific technologies. If the demand for such facilities grows, the EPA may expand or modify its facilities. In general, however, this program is intended to be incorporated into the EPA's long-term research and development programs and become a permanent part of the Agency's hazardous waste programs.

The Demonstration Phase: A Summary

Phase II, the Demonstration Phase, will be the most publicly visible of the four phases. Actual work will begin at Superfund sites during the demonstration phase and new technologies will be evaluated. Key events in the demonstration phase are summarized:

° Advertise in Commerce Business Daily

A notice requesting proposals was placed in the Commerce Business Daily (CBD) in early January 1987, and will be placed annually thereafter. Developers of new and innovative technologies are asked to obtain from EPA the information necessary to submit proposals for demonstrating their technology. Information about the Request for Proposals (RFP) can be obtained from Mr. Steve James (ORD) by calling 513/569-7877 (commercial), or 684-7877 (FTS).

In addition to choosing technologies based on the CBD advertisement, EPA has set up a second mechanism where innovative technologies may also be demonstrated as part of routine response actions. Superfund or other cleanup sites on which EPA is planning to use treatment technologies as part of the response action may be adapted for SITE demonstrations.

° Select Technologies

Potential new technologies will be carefully screened by OSWER and ORD. The screening process will be competitive and must be completed within 90 days of receiving the completed application. In selecting technologies to be demonstrated, EPA must consider, at a minimum, the following criteria:

1. The potential for contributing to solutions to those waste problems which pose the greatest threat to human health, which cannot be adequately controlled under present technologies, or which otherwise pose significant management difficulties.

2. The availability of technologies which have been sufficiently developed for field demonstration and which are likely to be cost-effective and reliable.

3. The availability and suitability of sites for demonstrating such technologies, and the capability to conduct demonstration projects in such a manner as to assure the protection of human health and the environment.

4. The likelihood that the data to be generated from the demonstration project at the site will be applicable to other sites.

° Match Technologies to Sites

Many of the new technologies may only be suited for specific kinds of wastes at a specific site. Using the expertise and knowledge in EPA Headquarters, laboratories, and the EPA regions, technologies will be matched with wastes at selected Superfund sites. The new Superfund law requires EPA to initiate a minimum of ten technology demonstrations each year. While most demonstrations will take place at Superfund sites, some technologies may be tested at commercial hazardous waste sites or at special test and evaluation facilities operated by EPA or the developer. Factors such as risk, public interest, expense, disposal of residues, and involvement of potentially responsible parties will be considered when matching sites and wastes with technologies.

° Conduct Demonstration

After reviewing and incorporating comments on the SITE demonstration plan, EPA will enter into a cooperative agreement with the developer of the technology. The demonstration may last several months, depending upon the time required to gather information on the effectiveness and reliability of the technology. The developer will provide the equipment and be responsible for setup and operation at the demonstration site. The technology will treat Superfund wastes during the test, but since it is only a demonstration, it will not be expected to clean up all of the wastes at the Superfund site. EPA's role will be to insure credible results by providing the testing protocols and procedures and preparing the analytical and quality assurance/quality control work plans so the performance data can be consistently and accurately interpreted.

° Complete Evaluation and Distribute Information

At the close of each demonstration, EPA will evaluate the results of all tests. If the results are positive, the technology could be applied at other similar Superfund sites. EPA will modify Agency procedures to encourage the use of these and other alternative technologies.

EPA will make available the results of each new technology to the hazardous waste cleanup industry, regulatory agencies, and the public. The Agency is developing a technology transfer program to ensure the distribution of accurate information as quickly as possible.

The Program to Date

The Superfund reauthorization calls for a minimum of ten field demonstrations per year through 1990. Congress authorized $20 million per year for the demonstration program, including demonstrations of innovative monitoring equipment. In FY'87, $8 million has been appropriated for this program.

In anticipation of reauthorization, EPA began setting up the SITE program in 1986. In March 1986, the first notice requesting proposals was placed in the CBD. Another notice appeared in January 1987. A brief description of the technologies which will be demonstrated in 1987 follows:

1. Biological Degradation of Organic Contaminants Process developed by Detox Industries, Inc., Sugar Land, Texas, biodegrades organic contaminants in water, sludge, and/or soil into harmless materials. Microorganisms developed by Detox are introduced into the waste media in a reactor. Proprietary ingredients are applied when necessary to adjust conditions for optimum biodegradation. Waste types to be treated during the demonstration are PCB-contaminated soils and sludges, and PAH/creosote soils.

2. Circulating Bed Combustion (CBC) process developed by Ogden Environmental Services, San Diego, California, is an advancement of the traditional fluidized bed combustion (FBC) technology which yields improved performance. The improvements arise from a higher gas velocity through the combustion chamber that produces a higher combustion efficiency. Waste material and limestone are fed into a combustion chamber along with recirculated bed material from a hot cyclone. The high turbulence in the combustor allows the process to destroy halogenated compounds such as PCB at temperatures below 850°C.

3. The Electric Pyrolyzer is a process developed by Westinghouse Waste Technology Services Division, Madison, Pennsylvania, to thermally destruct hazardous organic wastes without combustion. The process is designed as part of a mobile system unit. The system operates through a rapid transfer of energy to waste materials causing dissociation of organic molecules into individual atoms. Residence times for materials in the gaseous and liquid phases are fully controllable. Therefore, a wide range of destruction efficiencies may be obtained. Halogens, metals, and other impurities are trapped within a bath and the resultant product is a vitrified solid and clean off-gas. A wide range of organic and inorganic waste types is suitable for the process.

4. Incinetron Hazardous Waste Destruction System, Pure Oxygen Burner developed by Advanced Combustion Technologies, Inc., Norcross, Georgia, involves pure oxygen in combination with air and natural gas combusted to destroy liquid hazardous waste. This method allows higher burning temperatures without the addition of excess air. The ability to add oxygen without adding combustion air allows temperatures up to 4500°F. Conventional burners have a maximum of about 2400°F because of the problems encountered with adding air to the process. The burner will be installed in an EPA incinerator and evaluated.

5. Electric Infrared Incineration developed by Shirco Infrared Systems, Inc., Dallas, Texas, consists of a continuous conveyor belt furnace with associated material feed and discharge systems. In addition, a process control and instrumentation equipment, secondary combustion chamber, and mission control system are used. The incinerator conveyor moves waste material through insulated heating modules to volatilization/combustion temperatures by infrared heating elements. Rotary rakes turn the material to ensure mixing and complete burnout. Exhaust gases pass to a secondary chamber for destruction of residual organics and a venture scrubber/spray tower is utilized for particulate and acid control. Specific organic waste types include volatile and semi-volatile organics, PNA's, dioxins, pesticides, and PCB's. For inorganics the process showed that certain heavy metals can be thermally "fixed."

6. "CHLORANAN 20" Solidification Process developed by Hazcon, Inc., Katy, Texas, is a process where the reagent "CHLORANAN 20" is mixed with the organic waste stream and a cementitious product. The resultant mass becomes hardened and can be handled by a forklift within 3 hours if poured into forms. All blending is accomplished utilizing mobile field blending units that are totally enclosed to prevent volatile organic escape. Specific organic wastes include hydrocarbon waste from refinery operations, petrochemical, solvents, paint residue, and greases. For inorganics all heavy metals are suitable to treatment.

7. Pyroplasma System developed by the Westinghouse Plasma Systems, Madison, Pennsylvania, is a process based on the concept of pyrolyzing waste molecules using a thermal plasma field. The process destroys liquid organic wastes by dissociating the organic contents into their component elements. The plasma torch is the vital feature of the process. Liquid wastes are injected directly into the plasma with a temperature of 5000-20,000°C where the hazardous molecules are broken into their atomic states in an oxygen deficient atmosphere. The atoms recombine according to chemical kinetics. Specific organic wastes include methyl ethyl ketone (MEK), methanol (MeOH), ethanol (ETOH), carbon tetrachloride, and Askarel (PCB's and trichlorobenzene).

8. Vacuum Extraction of Volatile Contaminants from Soils and Groundwater was developed by Terra Vac, Inc., San Juan, Puerto Rico. The Terra Vac Process involves a mobile in-situ treatment which extracts the volatile contaminants from soils and groundwater by introducing a negative pressure gradient through the use of vacuum pumps. Air emissions of volatile organic compounds are controlled by carbon adsorption condensers or afterburners. Specific organic waste types include volatile organic compounds (VOC), hydrocarbons, and solvents in soils.

9. HWT Chemical Fixation Process developed by International Waste Technologies, Wichita, Kansas, is a system which consists of a two-phased reaction. The toxic elements and compounds are fixed in a fast-acting reaction with toxic metals and organics by intercalation compounds. In phase two, the macro-molecule framework is an irreversible colloid synthesis from a solid, to a gel, to a crystalline, three-dimensional, inorganic polymer. The bonding of hazardous elements and compounds is the development of the chemical reaction of the sulpho-ferri-aluminate hydrates. The admixtures used promote a better development of the IPN bonding as a result of the uniform microscopic distribution of HWT compounds. There are no known limitations for specific organic or inorganic waste types.

10. Plasma Arc Pyrolysis System developed by Pyrolysis Systems, Inc., and owned by New York State Department of Environmental Conservation, Albany, New York, is a mobile hazardous waste destruction system based upon the plasma pyrolysis of the waste chemical feed. It is similar in concept to the Westinghouse unit. It will be demonstrated on the sludges resulting from the Love Canal waste treatment plant.